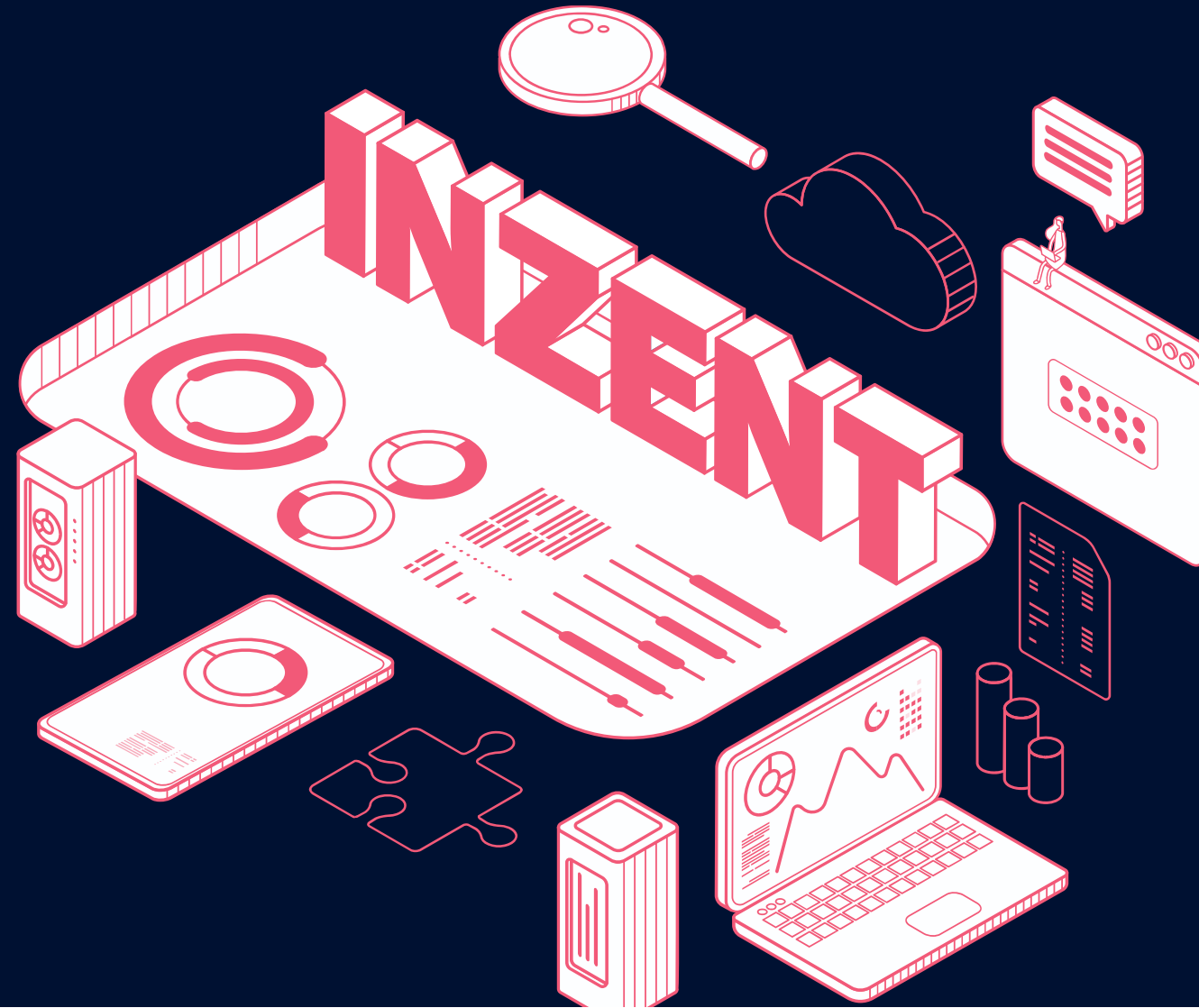


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인젠트  
유연우 수석

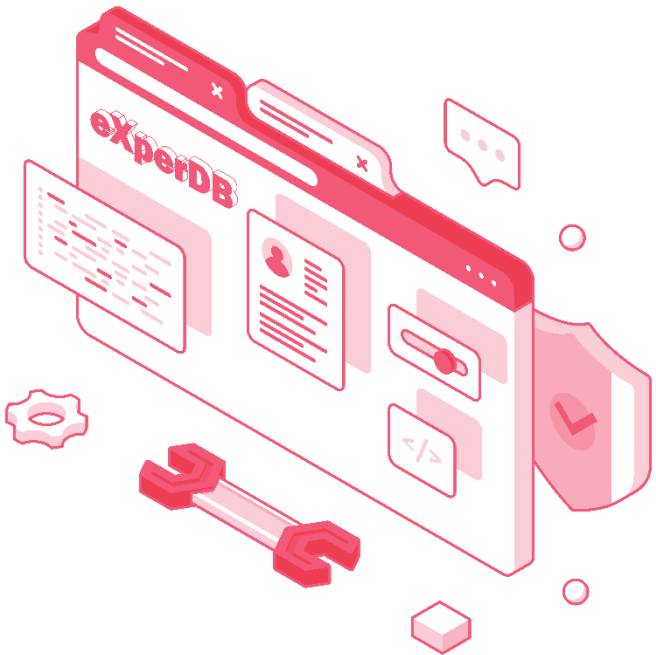


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---

# eXperDB in Kubernetes

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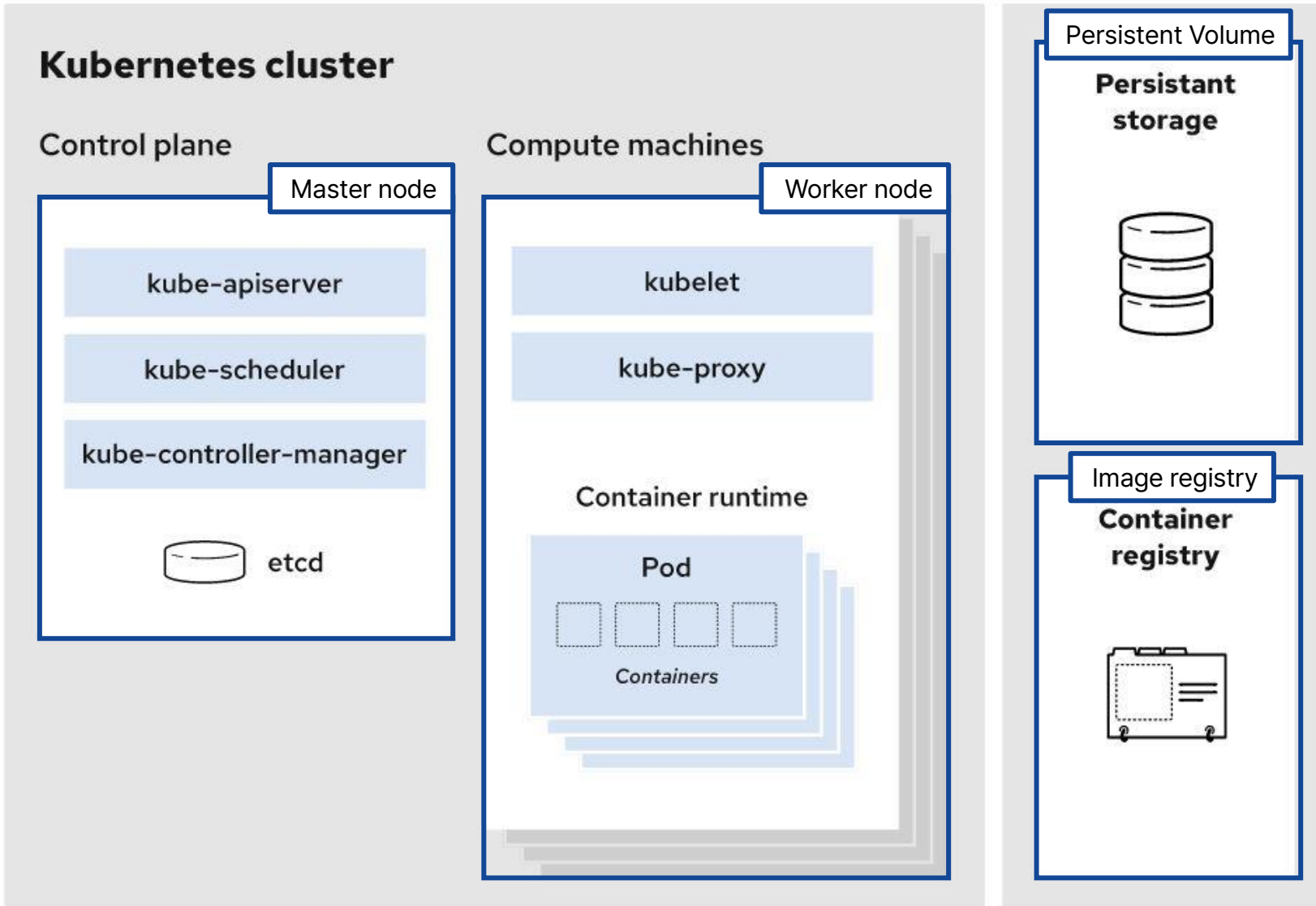
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# 1) Architecture



# 1. k8s Architecture



- Master node
- Worker nodes
- Persistent Volume
- Image registry

## 2. k8s Objects

- Node

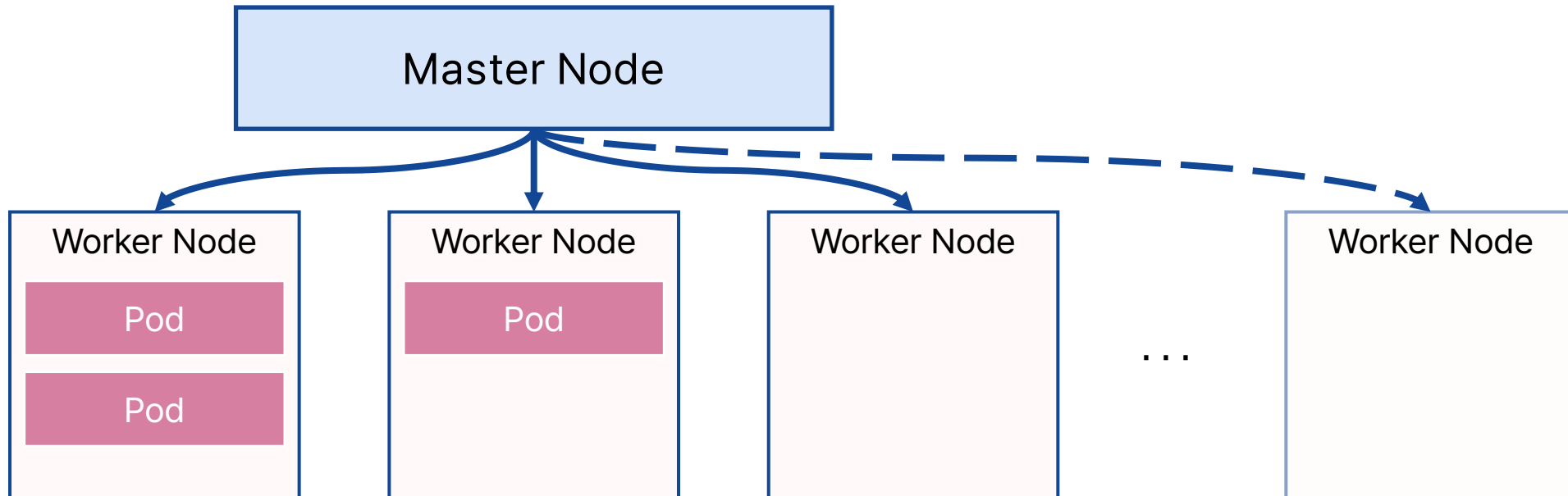
클러스터의 관리 대상으로 등록된 도커 호스트로, 도커 컨테이너가 배치되는 대상

쿠버네티스 클러스터에는 최소 1개 이상의 Master Node 필요

→ 일반적인 운영환경에서 최소 Master Node 3중화 이상

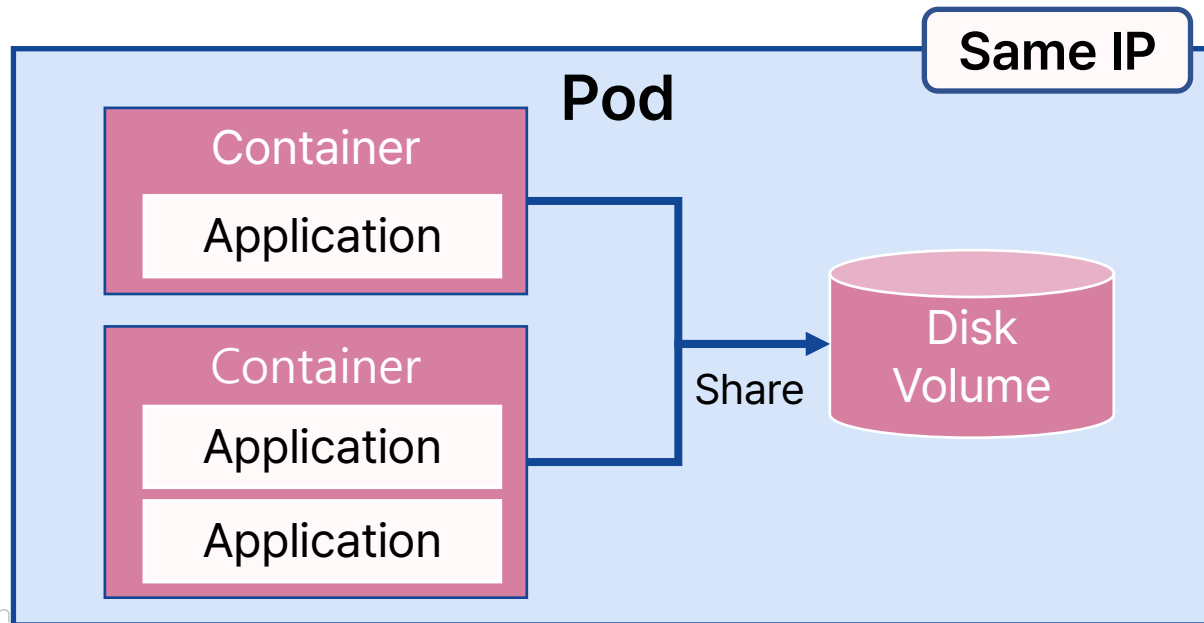
클러스터의 용량을 확장해야 된다면 Worker Node 추가

→ 일반적인 운영환경에서 Worker Node 는 서비스 운영에 필요한 만큼 확장 (ex. 0~300이상)



## 2. k8s Objects

- Pod
- 쿠버네티스 오브젝트 모델에서 가장 작고 단순한 유닛
- 쿠버네티스 포드는 Linux와 같은 컨테이너를 하나 이상 모아 놓은 것
- 각 포드는 컨테이너 실행 방식을 제어하는 옵션과 함께 컨테이너 하나 또는 긴밀히 결합된 일련의 컨테이너로 구성
- 포드 속의 각 컨테이너가 동일한 리소스 및 로컬 네트워크를 공유
- → 일반적인 운영환경에서 1 POD = 1 Container 구성
- 쿠버네티스의 가장 큰 특징은 컨테이너를 개별적으로 하나씩 배포하는 것이 아니라 Pod 라는 단위로 배포





## 2. k8s Objects

- Persistent Volume (Network Volume)

Kubernetes는 Pod가 기동될 때 default로 컨테이너 마다 Local Disk를 생성해서 기동

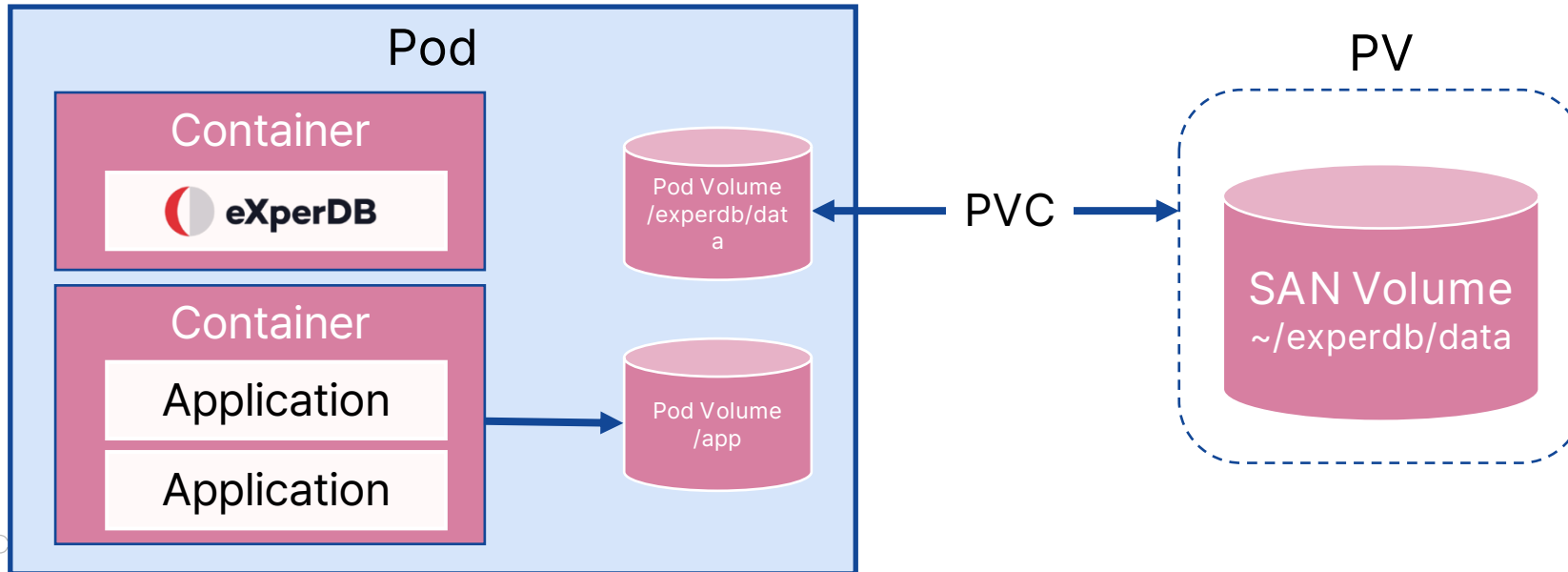
→ 이 로컬 디스크의 경우에는 영구적이지 못함

PV 볼륨은 컨테이너의 외장 디스크

→ Database와 같이 영구적으로 파일을 저장해야 하는 경우에 사용

PV : 시스템 관리자가 실제 물리 디스크를 생성한 후에, 이 디스크를 Persistent Volume이라는 이름으로 쿠버네티스에 등록

PVC : Pod의 볼륨과 이 PV를 연결하는 관계





## 2. k8s Objects

- Service

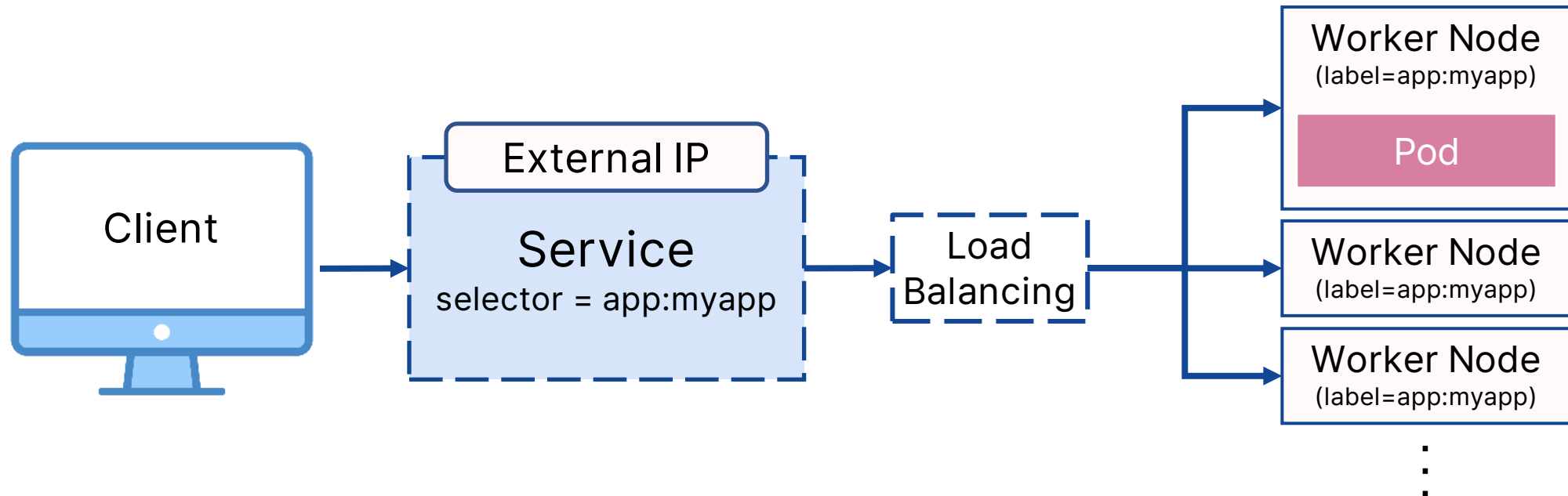
Pod의 논리적 집합이며 어떻게 접근할지에 대한 정책을 정의해 놓은 것

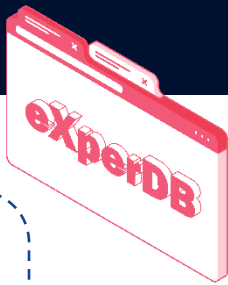
Pod의 경우 동적 생성이며, 장애 발생시 자동 리스타트 되면서 IP가 바뀌기 때문에 통신에 IP주소를 이용하는 것이 어려움

Service는 Label Selector 통해 정의가 가능

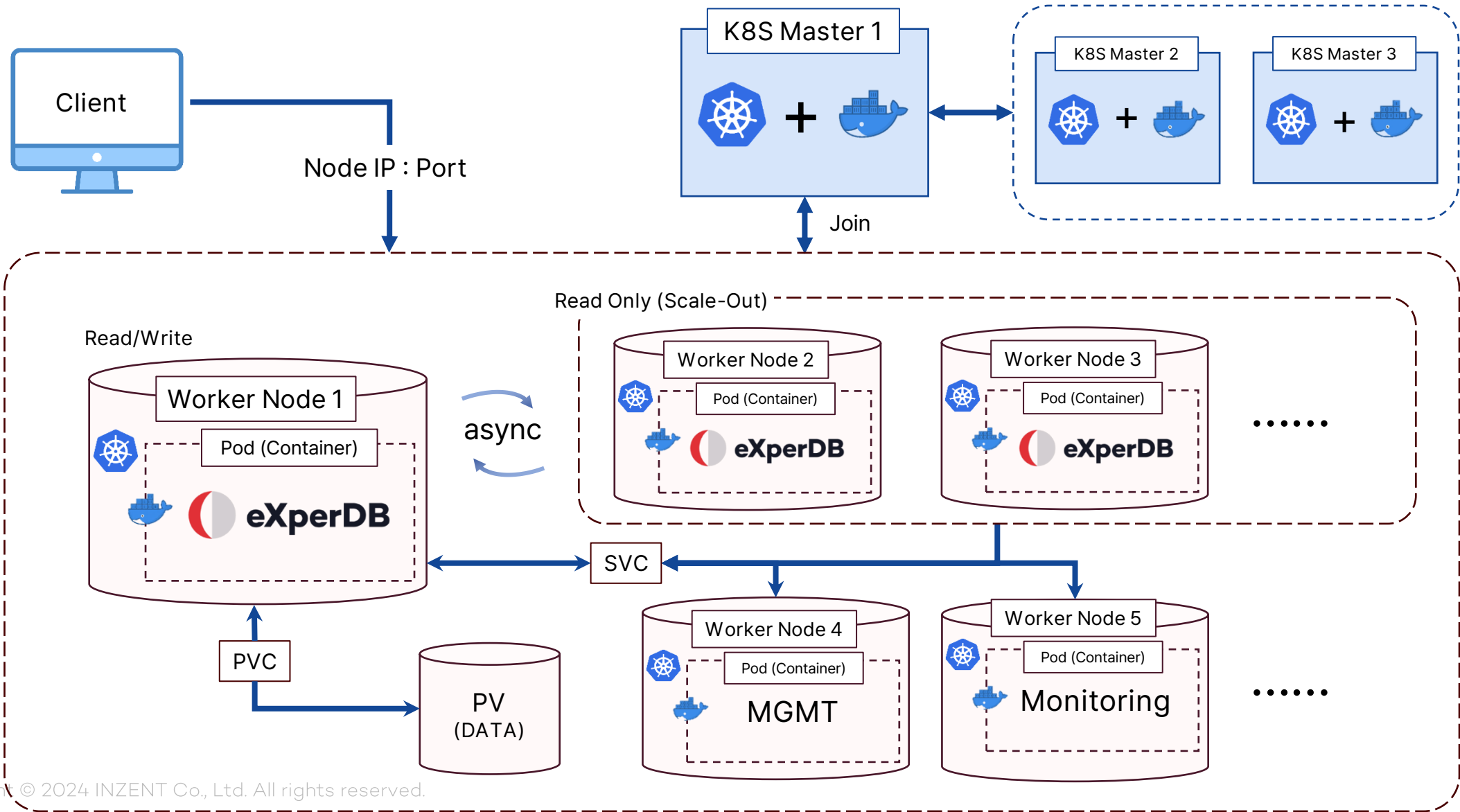
→ Label selector : 어떤 Pod를 서비스로 묶을 것인지를 정의

Pod의 IP로는 외부에서 접근이 불가능하지만, 서비스는 이를 가능하게 허용





### 3. k8s in eXperDB Architecture



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## 2) Consider Point



## 1. Kubernetes eXperDB 구성 시 고려사항

- ① Image File 을 보관할 Repository  
→ 가장 많이 쓰이는 DockerHub Private Registry 사용 권고
- ② Data 영역과 같은 영구 보존 Disk 정의  
→ PV 및 PVC 설정을 통한 Data File, Archive File, Log File 영구 보존 필요
- ③ DB 이중화 구성 및 동작 여부에 대한 내용  
→ Kubernetes 특성상 Pod 장애 발생시 자동으로 재기동되어 Split Brain 을 막기위한 수동 이중화 구성
- ④ 서비스 분산 처리에 필요한 eXperDB Scale Out 시 동작 여부  
→ Primary DB에서 Data 영역 복제 후 Read Only로 DB 기동하여 Replication 구성
- ⑤ Primary DB와 각각의 Pod끼리 통신하기 위한 Network 설정  
→ Primary DB의 IP를 고정하기 위한 Service 생성
- ⑥ 이외 Pod 가 기동되면서 동작해야 될 기술적인 부분  
→ 초기 구축시 고려사항(DB init), Pod 접속시 root 사용제한, Pod 생성시 DB 즉시 구동되게 설정 등

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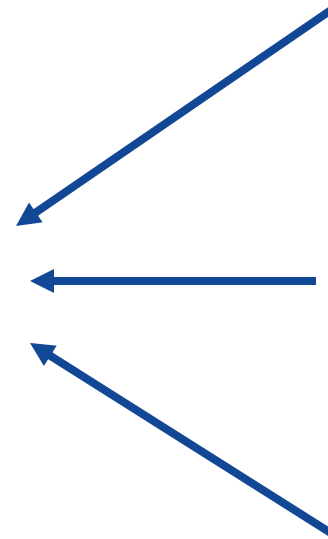
# 3) Image & Files

## 1. eXperDB Cloud Image File

Image Spec : CentOS 7.9 Ver / eXperDB 13.3 Ver

Image Name : experdb\_cloud\_13\_3.tar - CRUD DB (Primary)

experdb\_clone\_13\_3.tar - Read DB (Scale - Out)



각 서버에서 Image Download

## 2. YAML File

- PV YAML File

  
experdb-data-pv.yaml

  
experdb-arc-pv.yaml

  
experdb-log-pv.yaml

### experdb-data-pv.yaml

```
1 apiVersion: v1
2 kind: PersistentVolume
3 metadata:
4   name: experdb-data-pv
5 spec:
6   capacity:
7     storage: 5Gi
8   nfs:
9     path: /crio/host-cluster/experdb-volume/experdb-data
10    server: 172.30.1.49
11 persistentVolumeReclaimPolicy: Retain
12 volumeMode: Filesystem
13 accessModes:
14   - ReadWriteMany
```

## 2. YAML File

- PVC YAML File

  
experdb-data-pvc.yaml

  
experdb-arc-pvc.yaml

  
experdb-log-pvc.yaml

### experdb-data-pvc.yaml

```
1  apiVersion: v1
2  kind: PersistentVolumeClaim
3  metadata:
4    name: experdb-data-pvc
5    namespace: inzent-test
6  spec:
7    accessModes:
8      - ReadWriteMany
9    volumeMode: Filesystem
10   volumeName: experdb-data-pv
11   resources:
12     requests:
13       storage: 5Gi
```





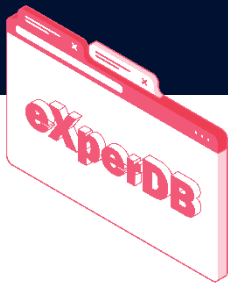
## 2. YAML File

- SVC YAML File



### experdb-svc.yaml

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: experdb-cloud
5    namespace: inzent-test
6    labels:
7      app: experdb-cloud
8  spec:
9    clusterIP: 10.96.10.10
10   clusterIPs:
11     - 10.96.10.10
12   ports:
13     - port: 5432
14       targetPort: 5432
15       name: experdb-cloud
16       protocol: TCP
17   selector:
18     app: experdb-cloud
19   type: NodePort
```



## 2. YAML File

- DBMS YAML File



### experdb-dbms\_cloud.yaml

```
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    name: experdb-cloud
..  ...
17  spec:
18    containers:
19      - name: experdb-cloud
20        image: 172.30.1.90:5000/experdb_cloud_13_3:1.0
21        ports:
22          - containerPort: 5432
23        imagePullPolicy: IfNotPresent
24        volumeMounts:
25          - mountPath: "/experdb_data/data/"
26            name: data-volume
..  ...
31    command: ['/bin/sh']
32    args: ['-c', '/home/experdb/eXperDB_start.sh']
33  volumes:
34    - name: data-volume
35      persistentVolumeClaim:
36        claimName: experdb-data-pvc
```



### 3. Pod Control File

- DBMS Start File



eXperDB\_start.sh



eXperDB\_standby\_start.sh

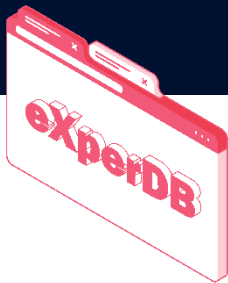
#### eXperDB\_start.sh

```
1 #!/bin/bash
2 source /home/experdb/.experdbrc
3 if [ "$(ls -A "$PGDATA" 2> /dev/null)" == "" ]; then
4     sudo chown -R experdb:experdb /experdb_data/
5     cd /home/experdb/
6     tar -xvf /home/experdb/init_data.tar
7     cp -r /home/experdb/data/ /experdb_data/
8     chmod 700 -R /experdb_data/
9     pg_ctl start
10 else
11     pg_ctl start
12 fi
13
14 while :
15 do
16     pg_ctl status
17     if [ $? -ne 0 ]; then
18         break
19     fi
20     sleep 5
21 done
```

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# 4) Installation



## 1. Kubernetes eXperDB 설치

- Docker Image Upload

```
[root@crio-acc-host-master experdb-scale]# podman load -i experdb_cloud_13_3.tar
Getting image source signatures
Copying blob 5d58b0ea5f53 done
Copying blob 174f56854903 skipped: already exists
Copying blob dd6ff4dd7cd7 done
Copying blob 9c7666e97e2b done
Copying config d212e0a539 done
Writing manifest to image destination
Storing signatures
Loaded image(s): localhost/experdb_cloud_13_3:1.0
[root@crio-acc-host-master experdb-scale]# podman load -i experdb_clone_13_3.tar
Getting image source signatures
Copying blob 174f56854903 skipped: already exists
Copying blob dd6ff4dd7cd7 skipped: already exists
Copying blob e268293ddf05 done
Copying blob 51440f42cfff done
Copying config 280ee77044 done
Writing manifest to image destination
Storing signatures
Loaded image(s): localhost/experdb_clone_13_3:1.0
[root@crio-acc-host-master experdb-scale]# podman images | grep experdb_clo
localhost/experdb_cloud_13_3          1.0          d212e0a53924  13 hours ago  1.15 GB
localhost/experdb_clone_13_3        1.0          280ee7704495  14 hours ago  937 MB
[root@crio-acc-host-master experdb-scale]#
```



## 1. Kubernetes eXperDB 설치

- PV 생성

```
[root@crio-acc-host-master experdb_yaml]# kubectl apply -f experdb-data-pv.yaml
persistentvolume/experdb-cloud-pv created
[root@crio-acc-host-master experdb_yaml]# kubectl get pv -n inzent-test | grep experdb
experdb-arc-security-pv          1Gi      RWX          Retain          Bound          22h          cubeone-test/experdb-arc-security-pvc
experdb-cloud-pv                5Gi      RWX          Retain          Available     19s
experdb-data-security-pv        5Gi      RWX          Retain          Bound          22h          cubeone-test/experdb-data-security-pvc
experdb-inforepo                10Gi     RWX          Retain          Bound          2d           inzent-test/experdb-inforepo-pvc
experdb-log-security-pv         1Gi      RWX          Retain          Bound          22h          cubeone-test/experdb-log-security-pvc
experdb-mgmt-pv                 10Gi     RWX          Retain          Bound          5d22h        inzent-test/experdb-mgmt-pvc
experdb-pv                       10Gi     RWX          Retain          Bound          5d22h        inzent-test/experdb-pvc
```



## 1. Kubernetes eXperDB 설치

- PVC 생성

```
[root@crio-acc-host-master experdb_yaml]# kubectl apply -f experdb-data-pvc.yaml
persistentvolumeclaim/experdb-cloud-pvc created
[root@crio-acc-host-master experdb_yaml]# kubectl get pv,pvc -n inzent-test | grep experdb
persistentvolume/experdb-arc-security-pv          1Gi          RWX          Retain          Bound          cubeone-test/experdb-arc-security-pvc
persistentvolume/experdb-cloud-pv                 5Gi          RWX          Retain          Bound          inzent-test/experdb-cloud-pvc
persistentvolume/experdb-data-security-pv         5Gi          RWX          Retain          Bound          cubeone-test/experdb-data-security-pvc
persistentvolume/experdb-inforepo                 10Gi         RWX          Retain          Bound          inzent-test/experdb-inforepo-pvc
persistentvolume/experdb-log-security-pv          1Gi          RWX          Retain          Bound          cubeone-test/experdb-log-security-pvc
persistentvolume/experdb-mgmt-pv                  10Gi         RWX          Retain          Bound          inzent-test/experdb-mgmt-pvc
persistentvolume/experdb-pv                       10Gi         RWX          Retain          Bound          inzent-test/experdb-pvc
persistentvolumeclaim/experdb-cloud-pvc           Bound        experdb-cloud-pv          5Gi          RWX
33s
persistentvolumeclaim/experdb-inforepo-pvc       Bound        experdb-inforepo         10Gi         RWX
2d
persistentvolumeclaim/experdb-mgmt-pvc           Bound        experdb-mgmt-pv          10Gi         RWX
5d22h
```



## 1. Kubernetes eXperDB 설치

- SVC 생성

```
[root@crio-acc-host-master experdb_yaml]# kubectl apply -f experdb_svc.yaml
service/experdb-cloud created
[root@crio-acc-host-master experdb_yaml]# kubectl get svc
NAME                TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)          AGE
kubernetes          ClusterIP    10.96.0.1     <none>         443/TCP         8d
[root@crio-acc-host-master experdb_yaml]# kubectl get svc -n inzent-test | grep experdb
experdb-cloud       NodePort     10.96.10.10   <none>         5432:30863/TCP   24s
experdb-platform   NodePort     10.107.146.69 <none>         5432:30247/TCP,5960:30431/TCP,8880:32641/TCP 5d21h
```





## 1. Kubernetes eXperDB 설치

- eXperDB Cloud 생성 (CRUD)

```
[root@crio-acc-host-master experdb_yaml]# kubectl apply -f experdb_dbms_cloud.yaml
deployment.apps/experdb-cloud created
[root@crio-acc-host-master experdb_yaml]# kubectl get pods -n inzent-test
NAME                                READY   STATUS              RESTARTS   AGE
apimportal-db7dfc97c-2rpbw          1/1    Running            0          5d2h
experdb-cloud-5bf7db7785-wzs69      0/1    ContainerCreating  0          28s
experdb-platform-866f56d9f5-85rd1   3/3    Running            0          5d4h
igate-6cb4cd79f7-8xkcf              1/1    Running            0          4d20h
imanager-c8469969c-nkqx4            1/1    Running            0          4d19h
infoseer-trans-7859b9d6d9-j4j4w     2/2    Running            0          2d
```

```
[root@crio-acc-host-master experdb_yaml]# kubectl get pods -n inzent-test
NAME                                READY   STATUS              RESTARTS   AGE
apimportal-db7dfc97c-2rpbw          1/1    Running            0          5d2h
experdb-cloud-5bf7db7785-wzs69      1/1    Running            0          43s
experdb-platform-866f56d9f5-85rd1   3/3    Running            0          5d4h
igate-6cb4cd79f7-8xkcf              1/1    Running            0          4d20h
imanager-c8469969c-nkqx4            1/1    Running            0          4d19h
infoseer-trans-7859b9d6d9-j4j4w     2/2    Running            0          2d
[root@crio-acc-host-master experdb_yaml]# kubectl exec -it experdb-cloud-5bf7db7785-wzs69 /bin/bash
kubectl exec [POD] [COMMAND] is DEPRECATED and will be removed in a future version. Use kubectl exec [POD] -- [COMMAND] instead.
Error from server (NotFound): pods "experdb-cloud-5bf7db7785-wzs69" not found
[root@crio-acc-host-master experdb_yaml]# kubectl exec -it experdb-cloud-5bf7db7785-wzs69 /bin/bash -n inzent-test
kubectl exec [POD] [COMMAND] is DEPRECATED and will be removed in a future version. Use kubectl exec [POD] -- [COMMAND] instead.
[experdb@experdb-cloud-5bf7db7785-wzs69 /]$ psql
psql (13.3)
Type "help" for help.

experdb=#
```



## 1. Kubernetes eXperDB 설치

- eXperDB Clone 생성 (Scale Out - Read Only)

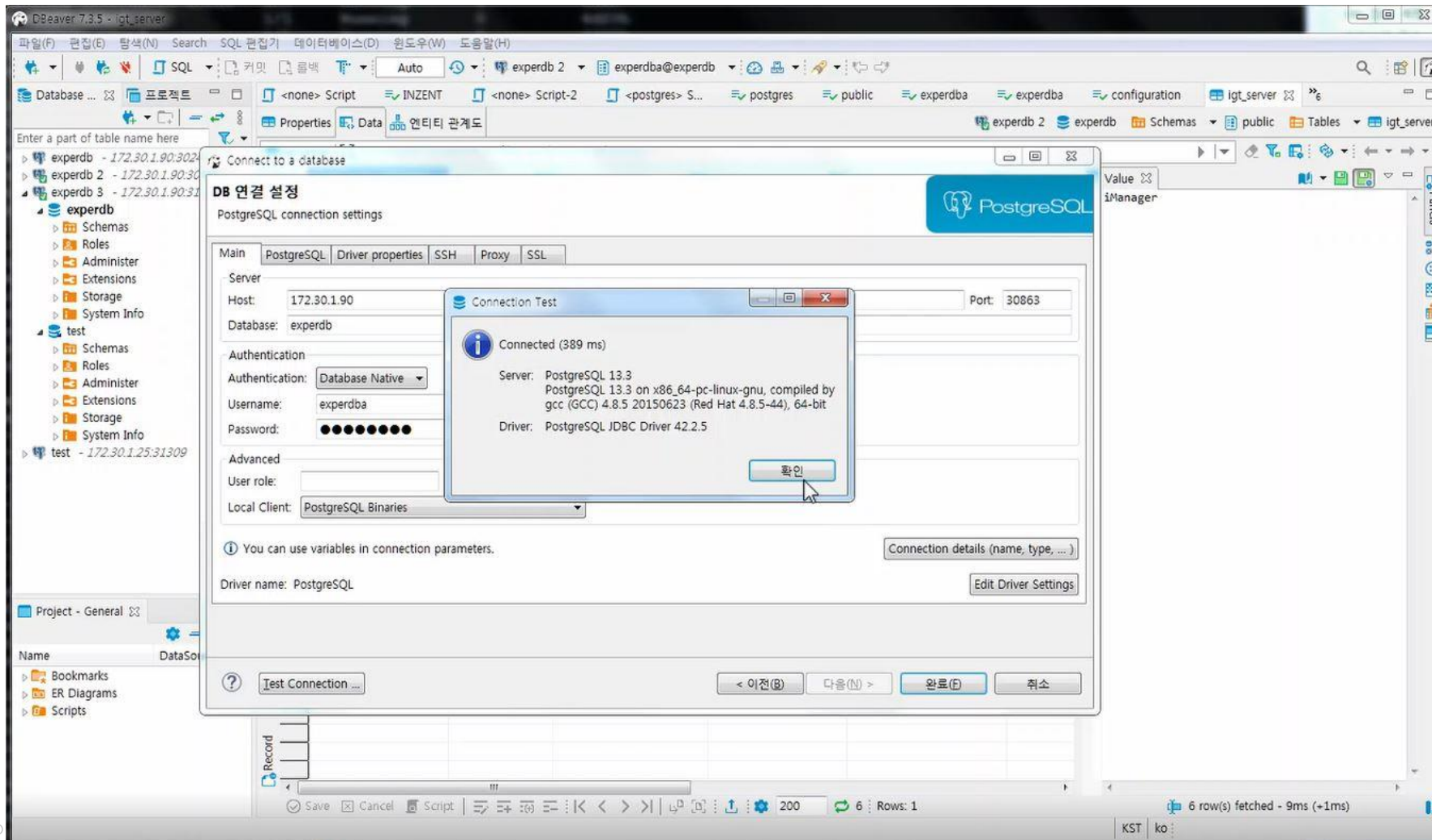
```
[root@crio-acc-host-master experdb_yaml]# kubectl apply -f experdb_dbms_clone.yaml
deployment.apps/experdb-clone created
[root@crio-acc-host-master experdb_yaml]# kubectl get pods -n inzent-test
NAME                                READY   STATUS              RESTARTS   AGE
apimportal-db7dfc97c-2rpbw          1/1    Running             0           5d2h
experdb-clone-76b68c74cd-5c46w      0/1    ContainerCreating  0           2s
experdb-clone-76b68c74cd-kkq86      0/1    ContainerCreating  0           2s
experdb-clone-76b68c74cd-md82n      0/1    ContainerCreating  0           2s
experdb-cloud-5bf7db7785-wzs69      1/1    Running             1           10m
experdb-platform-866f56d9f5-85rdl   3/3    Running             0           5d4h
igate-6cb4cd79f7-8xkcf              1/1    Running             0           4d20h
imanager-c8469969c-nkqx4            1/1    Running             0           4d20h
infoseer-trans-7859b9d6d9-j4j4w     2/2    Running             0           2d
[root@crio-acc-host-master experdb_yaml]# kubectl get pods -n inzent-test
NAME                                READY   STATUS    RESTARTS   AGE
apimportal-db7dfc97c-2rpbw          1/1    Running  0           5d2h
experdb-clone-76b68c74cd-5c46w      1/1    Running  0           6s
experdb-clone-76b68c74cd-kkq86      1/1    Running  0           6s
experdb-clone-76b68c74cd-md82n      1/1    Running  0           6s
experdb-cloud-5bf7db7785-wzs69      1/1    Running  1           10m
experdb-platform-866f56d9f5-85rdl   3/3    Running  0           5d4h
igate-6cb4cd79f7-8xkcf              1/1    Running  0           4d20h
imanager-c8469969c-nkqx4            1/1    Running  0           4d20h
infoseer-trans-7859b9d6d9-j4j4w     2/2    Running  0           2d
[root@crio-acc-host-master experdb_yaml]#
```





## 1. Kubernetes eXperDB 설치

- 외부 접속 TEST (DBeaver)

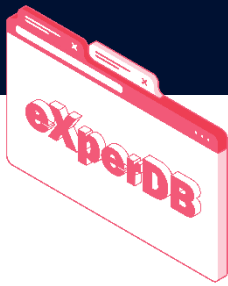


# 5) eXperDB Cloud의 가능성



## 1. Cloud 환경에서의 장점

- ① eXperDB 설치 **간소화**
- ② eXperDB Upgrade (Patch 등) **간편화**
- ③ 컴퓨팅 **리소스 활용성 증대**
- ④ 지속적인 상태 확인과 **셀프 힐링**
- ⑤ Auto Scaling



## 2. 확장 가능성

- Google Cloud, AWS, Microsoft Azure, NAVER CLOUD 등 eXperDB의 Cloud 시장 진출 가능성 Up



< 출처 : CNCF Cloud Native Interactive Landscape Database 부분 >



자유롭게  
질문 부탁드립니다.

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